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T.Y. B.Sc. (III Sem.) EXAMINATION, 2016

COMPUTER SCIENCE

Paper II

CS-332 : Theoretical Computer Science

(2013 PATTERN)

Time : Two Hours **Maximum Marks : 40**

N.B. :— (*i*) Neat diagrams must be drawn wherever necessary.

(*ii*) Figures to the right indicate full marks.

(*iii*) *All* questions carry equal marks.

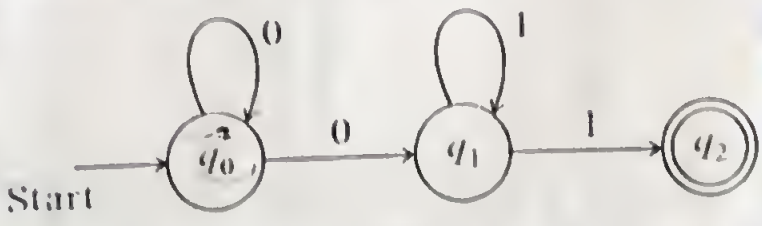
(*iv*) *All* questions are compulsory.

1. Attempt *all* of the following : [10×1=10]

(*a*) What are the proper prefixes and proper suffixes of the string "India" ?

(*b*) Define left linear and right linear grammar.

(*c*) Write the regular expression for the following FA :



RE = $q_0 = 0^*$

RE = $q_1 = 0^*01^*$

RE = $q_2 = 0^*01^*$

$0^* + 0^*01^* + 0^*0$

(*d*) Compare 'λ' function of Melay and Moore machine.

P.T.O.

(e) Write down the '∈-closure' of each state from the following FA :

(f) State the two different ways to simplify the CFG.

(g) State the machines used for context free grammar and context-sensitive grammar.

(h) Differentiate between PDA and FA.

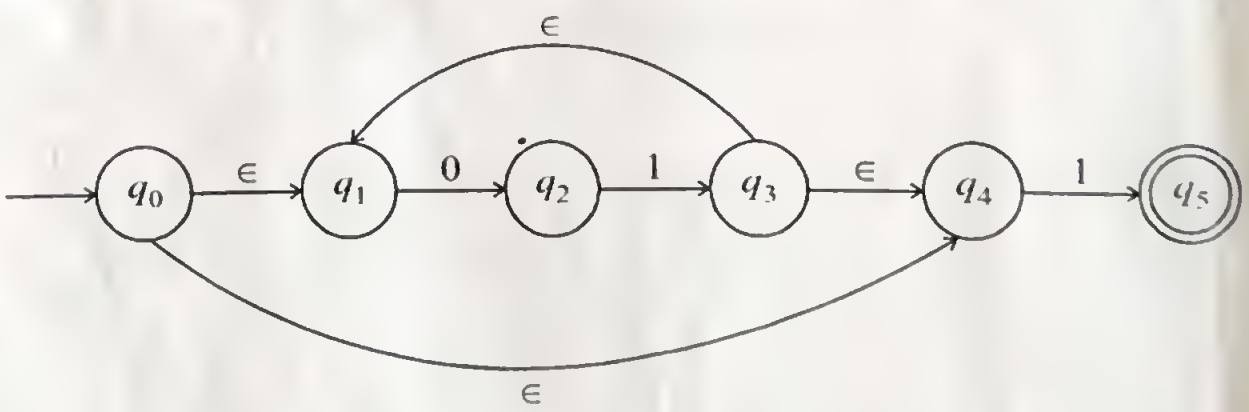
(i) Define tuples of LBA.

(j) State pumping lemma of regular set.

2. Attempt any *two* of the following : [2×5=10]

(a) Construct a DFA to accept all decimal numbers divisible by 3.

(b) Construct DFA equivalent to the following NFA :



(c) Construct FA for the following regular expression :

$(010 + 00)^* (10)^*$.

3. Attempt any *two* of the following : [2×5=10]

(*a*) Define PDA and construct PDA for $L = \{a^n b^m a^n \mid m, n \geq 1\}$.

(*b*) Construct the following CFG into Chomsky Normal Form (CNF) :

$S \rightarrow ABA$

$A \rightarrow aA \mid \in$ (epsilon)

$B \rightarrow bB \mid \in$ (epsilon)

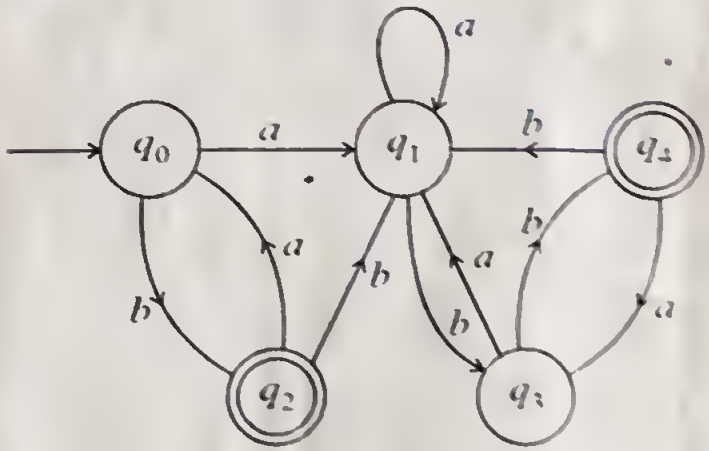
(*c*) Construct CFG for the following :

(*i*) $L = \{a^x b^y c^{x+y} \mid x, y \geq 1\}$

(*ii*) A language containing string having at least one occurrence of '00' over {0, 1}.

4. Attempt (A) *or* (B) :

(A) (*a*) Minimize the following DFA : [4]



(*b*) Explain the types of Turing Machine (TM). [4]

(*c*) Explain any *one* closure property of regular set. [2]

Or

(B) (a) Construct TM for $L = \{ww^R | w \in (0 + 1)^*\}$. [4]

(b) Convert the following CFG into PDA : [4]

$$S \rightarrow 1S|1S0S|1$$

Also show that the string "11101" is accepted by the PDA.

(c) Define the terms : [2]

(i) Ambiguous grammar

(ii) Parse tree.

(45)

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T.Y. B.Sc. (C.S.) (Third Semester) EXAMINATION, 2015

COMPUTER SCIENCE

CS-332 : Theoretical Computer Science

(2013 PATTERN)

Time : Two Hours **Maximum Marks : 40**

N.B. :— (*i*) Neat diagrams must be drawn wherever necessary.

(*ii*) Figures to the right indicate full marks.

(*iii*) *All* questions carry equal marks.

(*iv*) *All* questions are compulsory.

1. Attempt *all* of the following : [10x1=10]

(*a*) Define null string.

(*b*) Write smallest possible string from the following regular expression.

$$(a + b)\ (aa)^*\ (ab)$$

(*c*) Define ambiguous grammar.

(*d*) DFA has an E-transition. State True or False.

P.T.O.

DFA = NFA

(*e*) Describe the language for the following regular expression :

$$(00 + 11)\ (0 + 1)^*\ (00 + 11)$$

(*f*) Define nullable symbol and useless symbol.

(*g*) Define Type-2 grammar.

(*h*) Distinguish between TM and FA.

(*i*) Define ID of PDA.

(*j*) Define non-deterministic TM.

2. Attempt any *two* of the following : [2×5=10]

(*a*) Construct DFA to accept substring '101' or '001'.

(*b*) Construct Moore machine and Mealy machine which outputs even or odd according to number of *b*'s encountered are even or odd over $\Sigma = \{a, b\}$.

(*c*) Construct FA for the following regular expression.

$$a(a + b)^*\ b + b(b + a)^*a$$

3. Attempt any *two* of the following : [2×5=10]

(*a*) Construct TM for language :

$$L = \{a^m\ b^n\ c^m \mid m, n >= 0\}$$

(*b*) Construct NPDA for a language :

$$L = \{\omega\omega^R \mid \omega \in (0 + 1)^*\}$$

(c) Define Greibach Normal Form (GNF). Convert the following grammar into GNF :

A_1 S → ABA | AB | BA | AA | A | B

A_2 A → aA | a

A_3 B → bB | b

4. Attempt A *or* B : [10]

(A) (a) Show that the regular sets are closed under complementation. [4]

(b) Minimize the following DFA : [4]

	Σ / Q	a	b
Start	q_1	q_2	q_3
	q_2	q_3	q_3
	q_3	q_4	q_3
	q_4	q_3	q_5
*	q_5	q_2	q_5

where M = ($\{q_1, \ldots\ldots q_5\}$, $\{a, b\}$, δ, q_1, $\{q_5\}$)

(c) Explain types of regular grammar. [2]

Or

(B) (*a*) Construct a PDA which accepts a language : [4]

$$L = \{a^n \; b^{2n} \mid n \geq 1\}$$

(*b*) Construct CFG for the following : [4]

(*i*) $L = \{a^n \; b^m \; c^n \mid \; n > 1, \; m > 0\}$

(*ii*) $L = L_1 \cap L_2$

where $L_1 = \{a^n \; b \; a^n \mid n \geq 1\}$

L_2 = all strings having odd length over $\{a, b\}$

(*c*) State the differences between recursive and recursive enumerable language. [2]

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T.Y. B.Sc. (Semester III) EXAMINATION, 2017

COMPUTER SCIENCE

Paper II

CS-332 : Theoretical Computer Science (TCS)

(2013 PATTERN)

Time : Two Hours **Maximum Marks : 40**

N.B. :— (*i*) *All* questions are compulsory.
(*ii*) *All* questions carry equal marks.
(*iii*) Figures to the right indicate full marks.

1. Attempt *all* of the following : [10×1=10]

(*a*) Define regular expression.

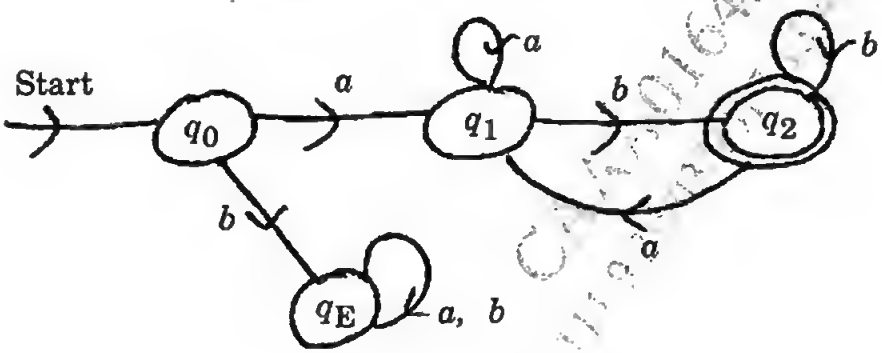
(*b*) Give the mapping of 'δ' function of NFA with ∈ moves.

(*c*) If A = {∈}. Find the value of |A|.

(*d*) Which tool is used to prove that the language is not regular ?

(*e*) Differentiate between Moore and Mealy machine.

(*f*) Give the language accepted by the following FA :



P.T.O.

(*g*) Define Kleene Closure.

(*h*) Write the tuples of Turing Machine.

(*i*) Define ID for PDA.

(*j*) Write a language for CFG :

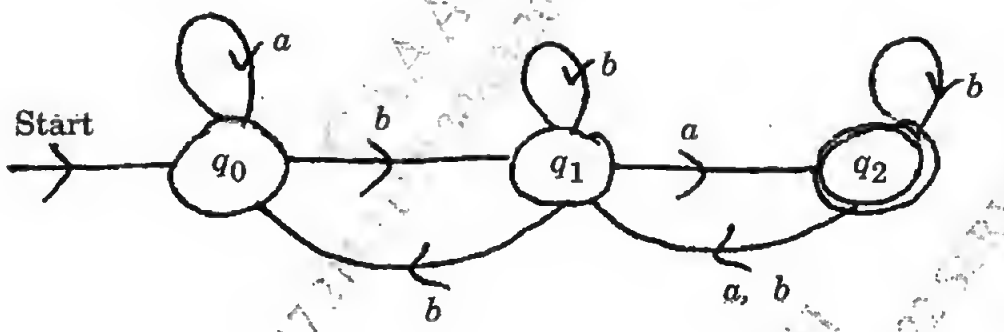
$S \rightarrow aSa|bSb|a|b|\in$.

2. Attempt any *two* of the following : [2×5=10]

(*a*) Construct a DFA to accept the set of all strings over $\Sigma = \{0, 1, 2\}$ such that the string ends with '012' or '20'.

(*b*) Construct a FA for the given RE : (a*b + b*a).ab + ba.b*.

(*c*) Convert the following given NFA to DFA :



3. Attempt any *two* of the following : [2×5=10]

(*a*) (*i*) Construct CFG for language $L = \{a^n b^m c^m d^n \mid n \geq 1, m \geq 1\}$.

(*ii*) Construct CFG for language L which accepts set of all palindromes over $\Sigma = \{a, b\}$.

(*b*) Rewrite the following CFG after eliminating useless symbols :

$S \rightarrow 0A0$

$A \rightarrow S1 | 1CC | D0A$

$C \rightarrow 011 | DD$

$E \rightarrow 0C$

$D \rightarrow 0DA$

(*c*) Construct a TM for $L = \{wcw^R | w \in (a + b)^*\}$.

4. (A) Attempt any *two* of the following : [2×5=10]

(*a*) Construct a Moore machine for a language L over $\Sigma = \{0, 1\}$ which outputs '$' if string ends with '100', outputs '#' if string ends with '001', otherwise outputs '*'.

(*b*) Construct a PDA for $L = \{0^m 1^n 2^n 0^m | m \geq 1, n \geq 1\}$.

(*c*) (*i*) Define Recursive language.

(*ii*) Differentiate between recursive and recursively enumerable languages.

Or

(B) Attempt any *two* of the following : [2×5=10]

(*a*) Convert the following grammar to GNF :

$S \rightarrow AB | B$

$A \rightarrow BS$

$B \rightarrow A1 | 1$

(*b*) Construct PDA equivalent to the given CFG :

$S \rightarrow aAb \mid aS$

$A \rightarrow Bb \mid a$

$B \rightarrow Sa \mid b$

(*c*) Minimize the following DFA :

$M = (\{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}, \{0, 1\}, \delta, q_0, \{q_1\})$

where δ is given by :

	δ	0	1
$\rightarrow$	q_0	q_4	q_0
	$*q_1$	q_1	q_0
	q_2	q_1	q_3
	q_3	q_7	q_2
	q_4	q_0	q_5
	q_5	q_1	q_4
	q_6	q_7	q_1
	q_7	q_3	q_7

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T.Y. B.Sc. (III Semester) EXAMINATION, 2016

COMPUTER SCIENCE

Paper II

[CS-332 : Theoretical Computer Science (TCS)]

(2013 PATTERN)

Time : Two Hours **Maximum Marks : 40**

N.B. :— (*i*) *All* questions are compulsory.

(*ii*) *All* questions carry equal marks.

(*iii*) Figures to the right indicate full marks.

1. Attempt *all* of the following : [10×1=10]

(*a*) State True *or* False. Is a*b* equal to (ab)*.

(*b*) Define NFA.

(*c*) Define proper suffix with the help of an example.

(*d*) Write the mapping of λ function in Mealy Machine.

(*e*) Give any *two* identities of regular expression.

(*f*) Define Multitape Turing Machine.

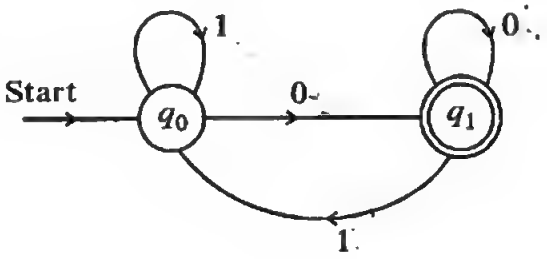
(*g*) State the machines used for CSG and CFG.

(*h*) Define ambiguous grammar.

P.T.O.

(*i*) Why is PDA more powerful than FA ?

(*j*) Give the regular expression for the following DFA.

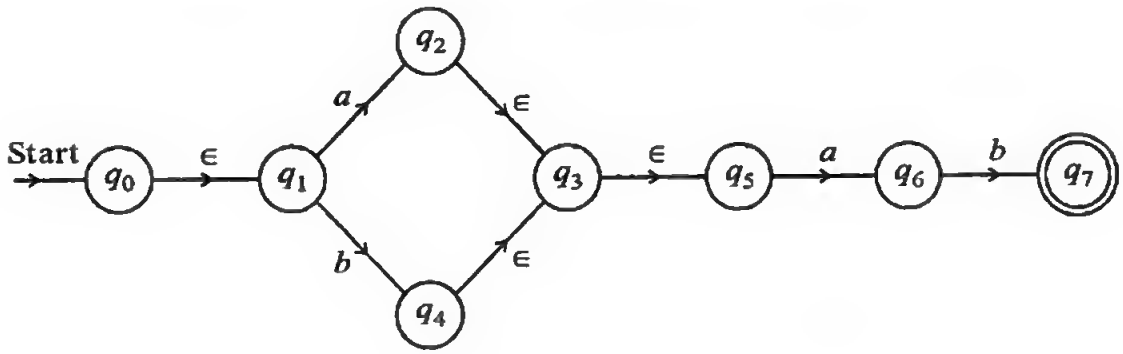


2. Attempt any *two* of the following : [2×5=10]

(*a*) Construct a DFA to accept the set of all strings over $\Sigma = \{a, b, c\}$ such that the string starts with '*ac*' and not having '*cab*' as a substring in it.

(*b*) Construct a NFA with ϵ moves for the given RE : $01(0+1)^* + 1^*.0^*$.

(*c*) Convert the following NFA with ϵ moves to DFA.



3. Attempt any *two* of the following : [2×5=10]

(*a*) (*i*) Construct CFG for language L = $\{a^n b^n c^m d^r \mid m, n, r \geq 1\}$.

(*ii*) Define Type-2 Grammar.

(*b*) Rewrite the following CFG after eliminating $\in$ productions :

S $\rightarrow$ AB | aBb

A $\rightarrow$ aA | $\in$

B $\rightarrow$ AD | aAb

D $\rightarrow$ bD | $\in$

(*c*) Construct a PDA for L = $\{a^m b^n c^{n+1} d^m \mid n \geq 1, m \geq 1\}$.

4. (A) Attempt any *two* of the following : [2×5=10]

(*a*) Construct a Mealy machine for a language L over Σ = {0, 1} which outputs '$' if string ends with '*aba*', outputs '#' if string ends with '*bab*', otherwise outputs '*'.

(*b*) Construct a TM for a language L, where L = $\{a^{m+n} b^m c^n \mid m, n \geq 1\}$.

(*c*) (*i*) Differentiate between DFA and NFA.

(*ii*) Differentiate between TM and LBA.

Or

(B) Attempt any *two* of the following : [2×5=10]

(*a*) Convert the following grammar to GNF :

S $\rightarrow$ AA | a

A $\rightarrow$ SS | b

(*b*) Construct PDA equivalent to the given CFG :

$S \rightarrow AA$

$A \rightarrow 0A0 | A1 | 1$

(*c*) Minimize the following DFA :

$M = (\{q_0, q_1, q_2, q_3, q_4\}, \{0, 1\}, \delta, q_0, \{q_2, q_4\})$ where δ is given by :

δ	0	1
$\rightarrow q_0$	q_1	q_2
q_1	q_1	q_3
$* q_2$	q_0	q_1
q_3	q_1	q_4
$* q_4$	q_3	q_1